

but they are not described herein because they are described in the co-pending applications previously identified above.

As noted earlier, the present invention capitalizes on the link bus and the link bus protocol to allow satellite devices and the link hub to disconnect and pace data transfers on the link bus with the use of a single status line. The invention allows transferring, retrying, aborting, or stalling data transfers in an efficient and timely manner, which prevents deadlocks, bottlenecks, etc. and improves the performance of the system utilizing the link bus. The transferring, retrying, aborting, and stalling operations are performed based on time-multiplexed transfer pacing and disconnecting status information that is transmitted in accordance with the link bus protocol.

It should be noted that the formats, timings and other definitions describing the link bus and the link bus protocol are mere examples. The invention is not to be limited to the specific examples described herein.

While the invention has been described and illustrated with reference to exemplary embodiments, many variations can be made and equivalents substituted without departing from the spirit or scope of the invention. Accordingly, the invention is not to be understood as being limited by the foregoing description, but is only limited by the scope of the appended claims.

What is claimed as new and desired to be protected by Letters Patent of the United States is:

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1. A method of transferring data in a processor based system, the system comprising a hub device coupled to a processor by a processor bus and coupled to a memory device by a memory bus, said hub device being connected to a first device by a link bus, the link bus having a status line, said method

5 comprising the steps of:

issuing, from one of the first device and the hub device, a data transfer request on the link bus;

obtaining a status of the request by observing the status line during a first predetermined window of time;

10 determining from the obtained request status whether a data transfer corresponding to the request should be initiated; and

initiating the data transfer if it is determined from the observed request status that the data transfer should be initiated.

2. The method of claim 1, wherein the data transfer request is a
15 command packet message constructed in accordance with a protocol of the link bus.

3. The method of claim 2 further comprising the step of driving, from an intended target of the transfer, the request status onto the status line based on information contained in the command packet message.

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4. The method of claim 3, wherein the information within the command packet comprises at least a size of the data transfer.

5. The method of claim 3, wherein the information within the command packet comprises at least a size and type of the data transfer.

5 6. The method of claim 3, wherein the information within the command packet comprises at least a size, attribute, and type of the data transfer.

7. The method of claim 1 further comprising the step of determining whether the transfer should be retried at a subsequent time if it is determined from the observed request status that the data transfer should not be initiated.

10 8. The method of claim 7 further comprising rescheduling the transfer if it is determined from the observed request status that the transfer should be retried.

9. The method of claim 8 further comprising the step of driving, from an intended target of the transfer, the request status onto the status line based on
15 information contained in the transfer request.

10. The method of claim 7 further comprising the step of determining whether the transfer should be aborted if it is determined from the observed request status that the data transfer should not be initiated and should not be retried.

11. The method of claim 10 further comprising the step of aborting the transfer if it is determined from the observed request status that the transfer should be aborted.

12. The method of claim 11, wherein said aborting step comprises:
5 bit bucketing write operations on the issuing device; and
returning a predetermined logical value for all read operations on the issuing device.

13. The method of claim 10, wherein the request status is driven onto the status line by a pull-up device connected to the status line.

10 14. The method of claim 1 further comprising:
obtaining a status of the initiated transfer by observing the status line during a second predetermined window of time;
determining from the obtained transfer status whether the initiated data transfer should be stalled; and
15 initiating a data transfer stall if it is determined from the observed transfer status that the data transfer should be stalled.

15. The method of claim 14, wherein said step of initiating a data stall comprises:

determining if the initiated transfer is on an allowable data boundary; and

stopping the transfer if it is determined that the transfer is on an allowable data boundary.

16. The method of claim 14 further comprising the step of driving,
from a target of the initiated transfer, the transfer status onto the status line when
the target must stall the transfer.

17. The method of claim 14 further comprising:

obtaining a status of the stalled transfer by observing the status line during a third predetermined window of time;

determining from the obtained stalled transfer status whether the stalled

10 data transfer should be continued; and

continuing the data transfer if it is determined from the observed stalled transfer status that the data transfer should be continued.

18. The method of claim 1 further comprising:

determining if the initiated transfer should be stalled; and

15 if it is determined that the initiated transfer should be stalled, driving a stalled status indication on the status line during a second predetermined window of time and stalling the transfer.

19. The method of claim 18, wherein said step of initiating a data stall comprises:

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determining if the initiated transfer is on an allowable data boundary; and
stopping the transfer if it is determined that the transfer is on an allowable data boundary.

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20. A method of receiving data in a processor based system, the system
5 comprising a hub device coupled to a processor by a processor bus and coupled to a memory device by a memory bus, said hub device being connected to a first device by a link bus, the link bus having a status line, said method comprising the steps of:

detecting, at one of the first device and the hub device, a data transfer
10 request on the link bus;

determining a status of a data transfer associated with the transfer request based on the transfer request; and

driving the status on the status line during a first predetermined window of time, wherein the status is selected from the group consisting of an accept status
15 indicating that the transfer can be initiated and a retry status indicating that the transfer should be retried at a subsequent period of time.

21. The method of claim 20, wherein the data transfer request is a command packet message constructed in accordance with a protocol of the link bus.

22. The method of claim 21, wherein the information within the command packet comprises at least a size of the data transfer and said step of determining the status of the transfer comprises:

determining whether the transfer can be accepted based on the size of the transfer;

driving the status line with the accept status if it is determined that the transfer can be accepted; and

driving the status line with the retry status if it is determined that the transfer cannot be accepted.

23. The method of claim 21, wherein the information within the command packet comprises at least a size and type of the data transfer and said step of determining the status of the transfer comprises:

determining whether the transfer can be accepted based on the size and type of the data transfer;

driving the status line with the accept status if it is determined that the transfer can be accepted; and

driving the status line with the retry status if it is determined that the transfer cannot be accepted.

24. The method of claim 21, wherein the information within the command packet comprises at least a size, attribute, and type of the data transfer and said step of determining the status of the transfer comprises:

continuing the data transfer if it is determined from the observed stalled transfer status that the data transfer should be continued.

28. The method of claim 25 further comprising the step of driving, from a target of the initiated transfer, a target stall status onto the status line when the target must stall the transfer.

29. The method of claim 28 further comprising:
driving, from the target, another target stall status onto the status line when the target determines that the data transfer should be continued.

30. A method of transferring data in a processor based system, the system comprising a hub device coupled to a processor by a processor bus and coupled to a memory device by a memory bus, said hub device being connected to a first device by a link bus, the link bus having a status line, said method comprising the steps of:

issuing, from one of the first device and the hub device, a data transfer request on the link bus;

detecting, at the other one of the first device and the hub device, the data transfer request on the link bus;

determining a status of a data transfer associated with the transfer request based on the detected transfer request;

driving the status of the data transfer on the status line during a first
predetermined window of time;

obtaining the status of the transfer by observing the status line during the
first predetermined window of time;

5 determining from the obtained status whether the data transfer
corresponding to the request should be initiated; and

initiating the data transfer if it is determined from the observed status that
the data transfer should be initiated.

31. The method of claim 30 further comprising the step of determining
10 whether the transfer should be retried at a subsequent time if it is determined from
the observed status that the data transfer should not be initiated.

32. The method of claim 31 further comprising rescheduling the
transfer if it is determined from the observed status that the transfer should be
retried.

15 33. The method of claim 31 further comprising the step of determining
whether the transfer should be aborted if it is determined from the observed status
that the data transfer should not be initiated and should not be retried.

34. The method of claim 33 further comprising the step of aborting the transfer if it is determined from the observed status that the transfer should be aborted.

35. The method of claim 34, wherein said aborting step comprises:
5 bit bucketing write operations on the issuing device; and
returning a predetermined logical value for all read operations on the issuing device.

36. The method of claim 34, wherein the status is driven onto the status line by a pull-up device connected to the status line.

10 37. A processor system comprising:
a processor;
a link hub connected to said processor via a processor bus;
a satellite device; and
a link bus connected between said link hub and said satellite device, said
15 link bus comprising a status line and a first bus, one of said link hub and said satellite device being a bus master and the other of said link hub and satellite device being a target, wherein said master issues a data transfer request on said first bus, obtains a status of the request by observing said status line during a first predetermined window of time, determines from the obtained request status
20 whether a data transfer corresponding to the request should be initiated, and

initiates the data transfer over said first bus when the data transfer should be initiated.

38. The system of claim 37, wherein the data transfer request is a command packet message constructed in accordance with a protocol of said link bus.

39. The system of claim 38, wherein said command packet comprises at least a size of the data transfer.

40. The system of claim 38, wherein said command packet comprises at least a size and type of the data transfer.

41. The system of claim 38, wherein said command packet comprises at least a size, attribute, and type of the data transfer.

42. The system of claim 37, wherein said master determines whether the transfer should be retried at a subsequent time when it is determined from the observed request status that the data transfer should not be initiated.

43. The system of claim 42, wherein said master reschedules the transfer when the transfer should be retried.

45. The system of claim 44 wherein said master aborts the transfer when

5 the transfer should be aborted.

47. The system of claim 42, wherein said status line is coupled to a pull-up device and the request status is driven onto said status line by said pull-up device.

48. The system of claim 37, wherein said master obtains a status of the initiated transfer by observing said status line during a second predetermined window of time, determines from the obtained transfer status whether the initiated data transfer should be stalled, and initiates a data transfer stall when the data transfer should be stalled.

49. The system of claim 48, wherein said master initiates a data stall by determining if the initiated transfer is on an allowable data boundary and stopping the transfer when the transfer is on an allowable data boundary.

50. The system of claim 48, wherein said target drives the transfer status onto said status line when said target must stall the transfer.

51. The system of claim 48, wherein said master obtains a status of the stalled transfer by observing said status line during a third predetermined window of time, determines from the obtained stalled transfer status whether the stalled data transfer should be continued, and continues the data transfer when the data transfer should be continued.

52. The system of claim 37, wherein said master determines if the initiated transfer should be stalled, drives a stalled status indication on the status line during a second predetermined window of time and stalls the transfer.

53. The system of claim 52, wherein said master initiates the data stall by determining if the initiated transfer is on an allowable data boundary and stopping the transfer when the transfer is on an allowable data boundary.

54. The system of claim 37, wherein said link bus is a source strobed bus.

55. The system of claim 54, wherein said first bus is a command/address/data bus.

56. A processor system comprising:

a processor;

a link hub connected to said processor via a processor bus;

a satellite device; and

a link bus connected between said link hub and said satellite device, said link bus comprising a status line and a first bus, one of said link hub and said satellite device being a bus master and the other of said link hub and satellite device being a target, wherein said target detects a data transfer request on said first bus, determines a status of a data transfer associated with the transfer request based on the transfer request, and drives the status on said status line during a first predetermined window of time, wherein the status is selected from the group consisting of an accept status indicating that the transfer can be initiated and a retry status indicating that the transfer should be retried at a subsequent period of time.

57. The system of claim 56, wherein said link bus is a source strobed bus.

58. The system of claim 56, wherein said first bus is a command/address/data bus.

59. The system of claim 56, wherein the data transfer request is a command packet message constructed in accordance with a protocol of said link bus.

60. The system of claim 59, wherein said command packet comprises at least a size of the data transfer and said target determines the status of the transfer by determining whether the transfer can be accepted based on the size of the transfer, driving said status line with the accept status when the transfer can be accepted, and driving said status line with the retry status when the transfer cannot be accepted.

61. The system of claim 59, wherein said command packet comprises at least a size and type of the data transfer and said target determines the status of the transfer by determining whether the transfer can be accepted based on the size and type of the data transfer, driving said status line with the accept status when the transfer can be accepted, and driving said status line with the retry status when the transfer cannot be accepted.

62. The system of claim 56, wherein said target obtains a status of an initiated transfer by observing said status line during a second predetermined window of time, determines from the obtained transfer status whether the initiated data transfer should be stalled, and initiates a data transfer stall when the data transfer should be stalled.

63. The system of claim 62, wherein said target initiates the data stall by ignoring any data transferred on the first bus.

64. The system of claim 62, wherein said target obtains a status of the stalled transfer by observing said status line during a third predetermined window

of time, determines from the obtained stalled transfer status whether the stalled data transfer should be continued, and continues the data transfer when the data transfer should be continued.

65. A processor system comprising:

5 a processor;

a link hub connected to said processor via a processor bus;

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a satellite device; and a link bus connected between said link hub and said satellite device, said link bus comprising a status line and a first bus, one of said link hub and said satellite device being a bus master and the other of said link hub
10 and satellite device being a target,

wherein said master and target being able to at least initiate, disconnect, retry, abort and stall data transfers on said first bus by time multiplexing disconnecting and pacing status information on said status line.

66. The system of claim 65, wherein said disconnecting information
15 comprises an accept status indicating that a data transfer can be initiated and a retry status indicating that the transfer should be retried at a subsequent period of time.

67. The system of claim 65, wherein said status line is connected to a pull-up device and a data transfer abort status is driven onto said status line by said
20 pull-up device.

68. The system of claim 67, wherein said pull-up device is a resistor.

69. The system of claim 65, wherein said pacing information comprises a stall transfer status indicating that a data transfer should be stalled and a continue status indicating that a stalled transfer should be continued.

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